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INCURABILITY OF CONGENITAL COLOR-BLINDNESS.[1]

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As most probably one person out of every twenty-five in the community is more or less color-blind, and as, besides the mortification or restricted sphere of employment this may entail, our lives and property are thereby endangered on railroads and vessels, the question of the curability of congenital color-blindness is one of considerable importance. Certainly the color-blind railroad employé or pilot should not be dismissed from service if he can be cured of his defect.

It has been till lately universally admitted by ophthalmic surgeons and physiologists that congenital color-blindness was incurable by any known means. In August, 1874, Dr. A. Favre, of Lyons, France, reported to the French Congress for the Advancement of Science, at Lille, some observations which seemed to him to prove that congenital color-blindness was curable both in children and adults by exercising the chromatic sense.[2] Dr. Favre has for the last twenty years or more, as consulting surgeon of the Paris-Lyon-Mediterranean railroad company, pressed the necessity of examining all railroad employés for color-blindness, led so to do principally by the results of Wilson and Potton. He has succeeded in inducing other roads to adopt similar precautions, and deserves great credit for his exertions. It is, therefore, due him to look carefully at his statements, as, if correct, they are of the utmost importance.

He reports the results in eleven different schools of the examination of one thousand and two boys between the ages of four and fifteen. These their teachers tested by asking them to name the color of objects exhibited of five principal colors. The teachers reported to Dr. Favre that they found at least two hundred and eighteen defective in chromatic sense, and that almost all were perfectly cured by being repeatedly shown objects and told the names of their colors *till they were learned.* Amongst one hundred and thirty-eight girls, from seven to fourteen years of age, Dr. Favre himself found only two whom he regarded as color-blind.

[1] Read at a meeting of the Suffolk District Medical Society, February 23, 1878. Reprinted from The Boston Medical and Surgical Journal, March 28, 1878.

[2] Le Traitement du Daltonisme dans les Écoles. Par A. Favre. Lyon. 1877.

These girls, he remarks, were under excellent teachers, and a large number had passed through the *salles d'asile* where colors were taught.

Dr. Favre then says, "The examination of these several reports shows that many children of both sexes come into the *salles d'asile* and schools without a notion of the elementary colors. The number of children lacking in this sensation in the majority of boys' schools I have visited is from twenty to thirty per cent. This ratio diminishes in proportion as the attention of the scholars is directed by their teachers to colored objects. Certain exercises, the painting of plans, geographical cards, lessons in natural history, etc., have an evident influence on the scholars' progress in this sense. Amongst the girls, sewing-work, embroidery, the care of the clothing, the handling of flowers, much reduces at eight years of age the number of those who have difficulty in distinguishing one or more of the elementary colors. At this age the number of boys who make marked mistakes in naming colors is still quite large, and we have found that if the majority easily acquire a knowledge of colors, many of these need watchful and continued care, requiring to be examined periodically, so to speak, till we are assured of their cure. What is the best method to use in the schools? Experience may teach us further, but from our observations during the last five years we feel authorized to draw the following conclusions: Male and female teachers should be required (1) to question, separately, the scholars of their class as to the five elementary colors, and also as to white and black. (2.) To carefully record at the time of examination the scholar's replies against his name. (3.) The scholars who have made mistakes should be individually called twice a week, and the colors named before them; they should be questioned and taught till it is shown that they have acquired an exact notion of the elementary colors. (4.) There should be periodic examinations. (5.) Whenever occasion presents, the precise names of colored objects exhibited should be spoken before the whole class. (6.) An advanced course on colors should be given scholars destined for special professions, by the aid of Chevreul's color chart and the most commonly manufactured articles."

"The treatment of color-blindness in the adult also has given us very conclusive results, which we have embraced in an unpublished article presented to the Academy of Science." Dr. Favre says again, elsewhere,[1] "I call for the introduction of exercises with colors in all the schools, in the army, in the marine, and on the railroads. I am persuaded that by the precautions I have indicated a great number of accidents may be avoided, and I hope to be so fortunate as to cause congenital Daltonism to be stricken from the nosological list."

Dr. Favre has here undoubtedly simply mistaken the lack of knowl-

[1] Résumé des Mémoires sur le Daltonisme. Présentés à l'Académie des Sciences. A. Favre. 1875.

edge of the *name* of a color for a lack of *perception* of the color. In this mistake he has been confirmed by the rather extraordinary reports from his several friends who were teachers. These latter, I must at once insist, were wholly incompetent to decide whether their scholars were color-blind. We must of course first positively prove the existence of the defect before we can talk about having cured it. It is next to impossible for even an expert to decide whether a child is color-blind by simply asking him to name the color of pieces of paper or other objects. It is, on the other hand, very possible to teach him a name which he shall attach to the object, as it would also be to teach a congenital blind person. These children, supposed color-blind, are reported as cured by more or less exercise with colors, according to their individual quickness and memory in catching and retaining their names. Those that were dull, inattentive, and forgetful required repeated exercises before they retained the names of colors which were seemingly readily forgotten. This is perfectly shown by the teachers' reports.

The reported percentage of defective color perception found would of itself throw much doubt on the method of testing. For instance, as many as thirty out of fifty and fifteen out of thirty-five children are reported having "no notion of color." But ten per cent. is a very large ratio even when we include all cases of only slight color-blindness. Now these children were from four to fifteen years of age. How many school-boys at this time of life know the names of five colors, or, having heard them, will apply them correctly when questioned, without being specially taught? We should probably find it very different with girls, as did Dr. Favre. They use the names of colors much more frequently, and have more to do with colored objects in dress, trimmings, etc.

Those of us who possess normal color perception know how difficult it is to tell the difference between light greens and blues. This formed a large class among these supposed defective children, and they were reported cured in four or five exercises. A further convincing proof of the inadequacy of the test employed, and of the disqualification of the teachers as examiners, is shown by their reporting children as confounding those colors which the color-blind never do; for example, red and violet. I would not of course deny that amongst these thousand children there were any color-blind. Proof to the contrary exists in the statement of one teacher who says, "I sometimes despaired of curing one child, six and a half years old, who, after sixty-five exercises, could not tell me a single color without hesitation. Eleven exercises more, however, cured this unexampled Daltonean, who began by first distinguishing green, and finished by not always calling red yellow when shown him." This child no doubt was color-blind, and took this length of time to learn the name of a color to be repeated whenever the same object was shown him. If alive, I am certain this boy is as color-blind now as then, and any test not calling for the use of names would

undoubtedly prove it. Professor Helmholz, in his Physiological Optics (page 299, 1867), said, "As to the examination of the color-blind, simply asking them to name this or that color will naturally elicit but very little, since they are then forced to apply the system of names adapted to normal perception to their own perception, for which it is not adapted. It is not only not adapted because it contains too many names, but in the series of spectral colors *we* designate differences of tone as such, which to the color-blind are only variations of saturation or luminosity. It is more than doubtful whether what they call yellow and blue correspond to our yellow and blue."

The lack of practical value of tests for color-blindness which require the examined to name colors has been well shown these last two years in the search for defective color perception amongst the *personnel* of the armies, navies, and railroads of Europe. It seems strange that Dr. Favre should have been led to conclude that color-blindness was so frequent as thirty or forty per cent., or that it was curable by exercise with colors, since his experience with railroad employés has been very large. He probably was deceived by using with these latter tests calling only for the naming of colors.

At first sight it seems only natural that we should be able to improve our color perception by use, as we may sharpen our other senses by exercise. But in the color-blind there is a congenital defect or deficiency. With the ear we may learn to distinguish sounds whose vibrations come within the range of our scale, but no amount of instruction can make us hear a note above or below the vibratory scale of our ear. A little practice will enable the normal eye to discriminate between the lighter shades of green and blue, which at first it had confounded, but no amount of exercise with colors can cause the color-blind eye to perceive those colors as we do, to whose ethereal wave lengths or numbers it is not adapted. However much practice may cultivate the power of an organ, it can never give that organ a different or additional power. I admit that constant exercise may enable a person only partially color-blind to improve his capacity for discriminating colors, but even then I do not believe he has altered his color perception, but only supplemented it by additional means, as we so often see other senses, when deficient, supplemented. Whether we shall ever be able to cure color-blindness is another question I am not in position to decide. I desire here only to state my belief, shared in at present by all physiologists and ophthalmic surgeons, that it has not been and cannot be cured by exercise with colors. From Dr. Favre's valuable researches, and his well-known and recognized connection with the present great advance in the testing for color-blindness amongst railroad employés and elsewhere, his belief in the curability of this defect might have undue weight. It must be remembered that he stands alone in this. I have therefore endeavored to show how and why he was mistaken, as others also might well be.

As to the necessity and value of teaching the names of colors in the lower schools, I entirely agree with Dr. Favre. No better proof of it can be given than the reports of his teacher friends, who found twenty to thirty per cent. of their pupils who did not know the names of colors, or could not apply them. Such recreations as color teaching would be interesting and valuable, since most probably all marked cases of color-blindness would be detected, and a scholar thus be warned in time not to attempt work in after-life for which his defect unfits him, of which he cannot be cured by any now known means.

The palliation of color-blindness by the use of colored transparent media has proved of so little value that I will not discuss it here, as also the other even less successful methods of improving or correcting this congenital chromatic defect suggested by one or another in past years. I should perhaps not dwell on this point further, were it not that Dr. Favre's mistake might lead to dangerous consequences by quieting the fears of those whose attention had been roused to the necessity of testing for color-blindness. I therefore quote from one or two authorities in support of my opinion, and to show that not only is it incurable, so far as we yet know, but that it does not change with time. A congenital color-blind person dies so. Professor Wilson says: [1] —

"*Congenital* color-blindness is certainly incurable, and, when induced by injury or disease, it may become as irremediable as if it had been an inherited peculiarity; but certain forms of this affection from disease or injury are transitory, and admit of cure. So far as I can ascertain from the examination of the cases of congenital color-blindness within my reach, the amount of modification in the perception of colors, induced by age, is inappreciable, even though no allowance be made for that alteration in all the powers of vision which time produces on every eye. Thus, Dalton was certainly as color-blind at the Oxford meeting of the British Association in 1832, when he compared the color of his D. C. L. gown to that of the leaves of trees, as in 1792, when he first discovered his color-blindness; [2] nor did any change, so far as his associates were aware, occur in his perceptions of color up to his death in 1844. Mr. Milne, of Edinburgh, is still (October, 1854) as color-blind as he was when Mr. Combe described his case thirty years ago, and as he had been for years before his case was described. Professor N —— was examined as to his perception of color some thirty years since by Sir David Brewster, who has recorded his case. He writes me recently: 'I am under the impression that some change in appreciating colors took place in my eye between childhood and youth. As a child, red gooseberries seemed to me altogether blue, so far as I remember; latterly I have observed what I fancy red in this variety of fruit.' And

[1] Researches on Color-Blindness. By George Wilson, M. D. Edinburgh. 1855.

[2] "A most amusing account was given by Babbage of the incidents attending the presentation of Dalton at court. Firstly, he was a Quaker, and would not wear the sword, which is an indispensable appendage of ordinary court dress. Secondly, the robe of a doctor of civil law was known to be objectionable on account of its color, — scarlet, — one forbidden to Quakers. Luckily, it was recollected that Dalton was afflicted with the peculiar color-blindness which bears his name, and that as the cherries and the leaves of a cherry-tree were to him of the same color, the scarlet gown would present to him no extraordinary appearance. So perfect, indeed, was the color-blindness that this most modest and simple of men, whose only pleasures were a pipe and a game of bowls, after having received the doctor's gown at Oxford, actually wore it for several days in happy unconsciousness of the effect he produced in the streets."— Scientific London, 1874, page 38.

again: 'I suppose sometimes that I can distinguish red in some objects, but probably this is from knowing that they are usually of this color.' But he adds: 'At any rate, I am quite sure I should make a dangerous railway signal man, as I most certainly would not know a red flag from a green one.' This gentleman further states, in answer to some queries, that *pink* still appears to him by daylight *blue* and by gas-light *green*, and that he continues to confound carmine-red by daylight with blue. There plainly has been nothing deserving the name of improvement in his case. Lastly, the Countess of D—— has not (in 1853) appreciably altered in her color-blindness since her peculiarities were described by Wallaston many years ago."

"Dr. K., a medical man, says: 'When a boy at school my attention was directed to my want of knowledge of color by finding I could not see what my father called the *bright-red* berries of the holly. When other children easily found out the trees which were loaded with ripe cherries, I never could, till I came so near the tree as to detect the form of the fruit. The discovery of this defect in vision distressed my father exceedingly, and he endeavored to cultivate in me a knowledge of color by giving me lessons in painting, making colored charts for me of the prismatic and other colors, wishing to believe that the defect resulted from want of education in color, not from a visual defect. I destroyed many a painting of flowers, etc., by putting on wrong colors, as blues for purples, green for some kinds of red, and yellow for others. I still remember the surprise he exhibited when he found I could not detect a red cloak spread over a hedge, across a narrow field; hedge and cloak appeared to me the same exact hue, and they do so to this day.'

"Dr. T., aged twenty-seven, early became aware of his inability to distinguish colors, and has cultivated painting in the hope of curing or diminishing his defect, but without any success. He has himself favored me with an account of his case, but as he very strongly realizes the want of a common language between himself and those who have not his defect in distinguishing colors, he regards this account as hopelessly imperfect.

"It is quite certain that dyers, painters, weavers, clothiers, and the members of other callings much conversant with color are not unfrequently color-blind. I myself have very recently been offered any 'reasonable fee' if I would cure a worthy working tailor of almost total inability to distinguish colors.

"These cases may suffice to illustrate the permanency of this affection of vision, but they are not singular. Among my color-blind acquaintances there are probably none who would not sacrifice a great deal to see perfectly; and nearly all have endeavored to cure themselves of their visual idiosyncrasy, but not one reports a cure, and the best educated and most observant among them are the most decided in declaring that they have given up all hopes of amendment.

"It is difficult to convince many that this conclusion is a just one. Those whose own sense of color is delicate, and who are led by taste or profession to live much among colored objects, are slow to believe that any eye can be so peculiar in its endowments as to make the blunders which the color-blind do, even in reference to what they call a 'staring' red or green. Such colorists insist that carelessness, indifference, or improper education lies at the bottom of the mistakes which the 'supposed' color-blind make, and profess themselves willing to undertake their cure, of which, however, they record no case.

"When we find an engraver, who for the greater part of his life has been gazing all day at paintings, purchasing a red window curtain for a green one; a tailor, whose eye has been for hours daily fixed on cloths of very varied colors, matching green tape with scarlet linen, at the risk of losing his situation; an experienced field geologist compelled, when surveying a red-sandstone district, to take a companion with him to point out where grass ends and sandstone begins; and a teacher of chemistry evading, as much as possible, the questions of his pupils concerning the colors of bodies, we cannot doubt that after education has done all that it can towards developing the sense of color in the color-blind, they remain as helplessly prone to make their characteristic blunders as before. A crowning example of this has recently presented itself to me. In the establishment of a painter and glass-stainer, who is an obstinate disbeliever in the existence of color-blindness, my attention was recently directed by his fellow-workmen to a youth who had been set to repaint the devices on the shafts of a sheaf of arrows. These devices, consisting of alternate circles of red and green, had not been effaced, but only dulled; yet the painter executed his task by painting all the *red* rings *green*, and all the *green* rings *red*. The case was remarkable for the direct reversal

of the colors in question, and this by one who held them before him to compare, both on his palette and on the arrows. Yet the party who committed the mistake was an excellent draughtsman, much esteemed by his master, and surrounded at his daily work with splendid specimens of stained glass. This mistake which he made soon ceased to be a solitary one; for his fellow-workmen, having since its occurrence put him to the test, found him uncertain in his judgment of many colors, and on examining him I found him commit the characteristic errors of the color-blind. Here, then, was the possessor of an educated color-blind eye making such mistakes as no normal-eyed person, however uneducated his power of vision might be, could or would make. Education, then, can do nothing towards curing congenital color-blindness, nor in truth can anything else."

Dr. Goubert, in 1867, says as to treatment of color-blindness:[1] "I have here no more consoling words or fruitful resources to present. Whatever the symptoms characterizing this peculiar imperfection, it belongs to that large number which the divine art of Æsculapius is powerless to cure, perhaps even to mitigate. All ophthalmic surgeons are unanimous on this point."

Professor Holmgren, of the University of Upsala, Sweden, has very thoroughly discussed Dr. Favre's publications, and he is in position both theoretically and practically to test attempts to cure color-blindness by exercise with colors, etc. After citing from his pamphlets, he says:[2] "This does not materially change the point of view we have adopted and indicated. It will be admitted that to positively prove the curability of color-blindness it is indispensable to establish the fact, first, that the treatment was applied to persons who were proven color-blind; and secondly, that these same persons after treatment had perfectly normal color vision, or were not deficient in it. Dr. Favre's *brochure* does not give us sufficient proofs of this. In short, without denying, on theoretical or practical grounds, the curability of color-blindness, we must hold that as yet no positive proof of it has been furnished.

"We, on our part, have not yet seen the result of a systematic exercise in learning colors pursued months or years; but the observations we have made on the exercise of the color-blind and their general effects may not be without interest, and throw some light on the importance of such exercise. We have said that the color-blind railroad employés learn to distinguish the flag signals in common use, and rarely make a mistake when examined especially on this point. Does this result depend on the training, and in what way? The color-blind who are not railroad employés can answer this. If we show them the ordinary flags (green and red) one after the other, they will nearly always name one or the other wrongly, and often both, and even sometimes frankly admit they do not know the true names of the colors. But if we show them the two flags at the same time, and ask which is green and which red, they at once see a difference; and, having fixed the name in their memory, they no longer make mistakes, but will tell the

1 De l'Achromatopsie ou Cécité des Couleurs. Dr. E. Goubert. Paris. 1867.
2 De la Cécité des Couleurs. F. Holmgren. Stockholm. 1877.

true name of the colors, even when shown one flag after the other. From this we see how the color-blind railroad employé has learned to distinguish the flags.

"But, after all, what have they learned, and what, strictly speaking, have they gained, by such recognitions? If we ask a color-blind person who is intelligent and honest, and who has no interest in concealing his fault, he will openly admit that he has no idea of the color itself, but that he notices a sensible difference in that the green flag is darker to his eye than the red. At the next trial he will make the same mistake if the first flag is shown him alone, and will be as surely correct if the two are shown together. A railroad employé who daily sees the two flags will not in general make this mistake when the test is repeated; we readily understand why. The color-blind has learned to apply the names, guiding himself by the difference in the intensity of the light. But he still continues destitute of any idea of color. He is always color-blind, and has simply learned an artifice.

"If Dr. Favre's claim that the railroad and marine *personnel* should be trained and exercised in telling colors is formally entertained, it can but lead to admitting the color-blind to positions in question; and, moreover, in the assurance that their congenital defect can be cured by the performance of their duty, the necessary training is looked out for. Such advice, we think, is positively dangerous, as it only deceives the authorities into the idea that the color-blind can cause no accident; whilst in reality their defect is where it was before, and, moreover, from this training becomes more difficult, I may say impossible, to discover, if a faulty method of testing is employed. In this point of view the training, far from averting, only increases the danger."

I think the necessity of discussing as far as I have what at first sight seemed perhaps only a medical opinion has now been made apparent. The very mistake Dr. Favre has been led into has also deceived railroad officials, who here and there have tested an employé suspected of color-blindness with the flags or lanterns used on their individual roads. It requires considerable argument and positive proof to convince a railroad superintendent that one of his men whom he has had cause to suspect, and has seemingly thoroughly tested, is after all color-blind. It is very difficult for him not to believe his employé has learned, or can be made to learn, to see colors as they appear to a normal eye. He, however, will be convinced against his reason, when the color-blind man is in his presence subjected to a proper scientific test applied by a competent specialist.